INTERNATIONAL STANDARD

ISO 6916-1

First edition
1995-07-15

Flexible cellular polymeric materials — Sponge and expanded cellular rubber products — Specification —

Part 1:
Sheeting

Polymères alvéolaires souples — Caoutchoucs alvéolaires mousses et souples — Spécification —

Partie 1: Feuille

Reference number
ISO 6916-1:1995(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 6916-1 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*.

ISO 6916 consists of the following parts, under the general title *Flexible cellular polymeric materials — Sponge and expanded cellular rubber products — Specification*:

— *Part 1: Sheeting*

— *Part 2: Mouldings and extrusions*

Annexes A to G form an integral part of this part of ISO 6916.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Flexible cellular polymeric materials — Sponge and expanded cellular rubber products — Specification —

Part 1:
Sheeting

1 Scope

1.1 This part of ISO 6916 classifies flexible cellular rubber products known as sponge and expanded rubber. The base material used in their manufacture may be natural rubber, reclaimed rubber or synthetic rubber, either alone or in combination. The only products included in this part of ISO 6916 are in the form of sheeting.

1.2 This part of ISO 6916 does not apply to latex foam rubbers, shoe soling or other similar micro-cellular products, ebonite cellular rubbers, virgin or reconstituted flexible, semi-rigid urethane foams, virgin or reconstituted poly(vinyl chloride), or poly(vinyl chloride) blended with other polymers.

1.3 Two types are specified, as follows:

Type 1: open-cell rubber (normally known as sponge rubber).

Type 2: closed-cell rubber (normally known as expanded rubber).

These types are further classified by division into classes, based on their relative resistance to the action of petroleum-based oils and/or temperature resistance, and grades, based on a specific range of compression-deflection requirements. The product can be further classified by the addition of a suffix letter to the type, class and grade designation to indicate additional requirements. This letter is then defined by a suffix number denoting a test method.

1.4 Attention is drawn to the fact that most extruded or moulded shapes are of sizes too small for cutting standard test pieces. These are difficult to classify and test by the methods given in this part of ISO 6916 and cannot, therefore, be tested using these procedures.

In the case of conflict between the provisions of this part of ISO 6916 and those of the detailed specification or test method for a particular product, the latter shall take precedence. Reference to the methods shall specifically state the desired test or tests.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 6916. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 6916 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 188:1982, *Rubber, vulcanized — Accelerated ageing or heat-resistance tests.*

ISO 471:1995, *Rubber — Times temperatures and humidities for conditioning and testing.*

ISO 815:1991, *Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures.*

ISO 1431-1:1989, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static strain test.*

ISO 1817:1985, *Rubber, vulcanized — Determination of the effect of liquids.*

ISO 1923:1981, *Cellular plastics and rubbers — Determination of linear dimensions.*

ISO 3865:1983, *Rubber, vulcanized — Methods of test for staining in contact with organic material.*

ISO 5893:1993, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Description.*

NOTE 1 In some of the test methods referenced above, the apparatus, but not procedure, is used.

3 Classification (types, classes, grades and suffixes)

3.1 Types

This part of ISO 6916 covers two types of cellular rubber, as follows:

Type 1: open-cell rubber.

Type 2: closed-cell rubber.

3.2 Classes

Each type is divided into four classes designated by the letters A, B, C and D (for example type 1B).

Class A: Cellular rubbers made from natural rubber, reclaimed rubber or synthetic rubber alone or in combination, where specific resistance to the action of petroleum-based oils is not required.

Class B: Cellular rubbers made from synthetic rubber having specific requirements for oil resistance with low swell.

Class C: Cellular rubbers made from synthetic rubber having specific requirements for oil resistance with medium swell.

Class D: Cellular rubbers made from synthetic rubber having specific requirements for both low and high temperature resistance (−75 °C to 250 °C) but where specific resistance to the action of petroleum-based oils is not required.

3.3 Grades

Each class is divided into six different grades based on a specific range of firmness as expressed by compression deflection. Grades are designated by a digit (0 to 6), with the softer grades being identified with the lower numbers and the harder grades with the higher numbers.

Grade 0: for type 1 cellular rubbers only, a compression-deflection range of 2,5 kPa to 15 kPa.

Grade 1: for type 1 and 2 cellular rubbers, a compression-deflection range of 15,1 kPa to 35 kPa.

Grade 2: for type 1 and 2 cellular rubbers, a compression-deflection range of 35,1 kPa to 65 kPa.

Grade 3: for type 1 and 2 cellular rubbers, a compression-deflection range of 65,1 kPa to 95 kPa.

Grade 4: for type 1 and 2 cellular rubbers, a compression-deflection range of 95,1 kPa to 125 kPa.

Grade 5: for type 1 and 2 cellular rubbers, a compression-deflection range of 125,1 kPa to 200 kPa.

Grade 6: for type 1 and 2 cellular rubbers, a compression-deflection range of 200,1 kPa to 300 kPa.

3.4 Suffix letters

Suffix letters may be added singly or in combination after any grade number to indicate additional requirements beyond those specified in tables 1 and 2 as basic requirements. The significance of the approved suffix letters is shown in table 3.

3.5 Suffix numbers

Each suffix letter should preferably be followed by one suffix number. The suffix number always indicates the test method. The time of test is part of the method and is taken from the listing in table 4.

NOTE 2 Examples of codings:

a) 1A2C1F1: This is an open-cell, non-oil-resistant material, firmness 35,1 kPa to 65 kPa, compression set at basic level, ozone-resistant to 25 pphm, and low-temperature-resistant to −40 °C.

b) 1C3B1C1F2: This is an open-cell material, oil-resistant at the medium swell level, firmness 65,1 kPa to 95 kPa, compression set 25 % max., ozone-resistant to 25 pphm, and low-temperature-resistant to −55 °C.

4 Material and workmanship

4.1 Cellular rubbers produced to this part of ISO 6916 shall be manufactured from natural rubber, synthetic rubber or reclaimed rubber, together with added compounding ingredients of such nature and quality that the product complies with the specification requirements.

4.2 In permitting choice in the use of materials, it is not intended to imply that the resulting different

rubber materials are equivalent in respect of all physical properties. Any special characteristics other than those specified in this part of ISO 6916 which may be desired for a specific application shall be detailed in the particular product specification. All materials and workmanship shall be in accordance with good commercial practice, and the resulting cellular rubbers shall be free from defects affecting serviceability.

These products shall also conform with national and supranational health and safety regulations.

Table 1 — Physical requirements for cellular rubbers, type 1, open-cell (sponge) rubber

Basic requirements							
Grade No.	Compression deflection at 25 % Deflection at 23 °C ± 2 °C	Compression deflection after conditioning — Change from original value			Compression set under constant deflection of 50 %		Oil resistance 22 h at 70 °C ± 1 °C Change in volume in ISO 1817 petroleum-based oil No. 3
		168 h at 70 °C ± 1 °C	22 h at 150 °C ± 2 °C	5 h at −55 °C ± 2 °C	22 h at 70 °C ± 1 °C	22 h at 100 °C ± 1 °C	
	kPa (Limits)	% (Limits)	% (Limits)	% (Max.)	% (Max.)	% (Max.)	% (Limits)
Class A, non-oil-resistant							
1A0	2,5 to 15	±20 [1]	—	—	25	—	—
1A1	15,1 to 35	±20	—	—	25	—	—
1A2	35,1 to 65	±20	—	—	25	—	—
1A3	65,1 to 95	±20	—	—	25	—	—
1A4	95,1 to 125	±20	—	—	25	—	—
1A5	125,1 to 200	±20	—	—	25	—	—
1A6	200,1 to 300	±20	—	—	25	—	—
Class B, oil-resistant, low-swell							
1B0	2,5 to 15	±20 [1]	—	—	40	—	−25 to +10
1B1	15,1 to 35	±20	—	—	40	—	−25 to +10
1B2	35,1 to 65	±20	—	—	40	—	−25 to +10
1B3	65,1 to 95	±20	—	—	40	—	−25 to +10
1B4	95,1 to 125	±20	—	—	40	—	−25 to +10
1B5	125,1 to 200	±20	—	—	40	—	−25 to +10
1B6	200,1 to 300	±20	—	—	40	—	−25 to +10
Class C, oil-resistant, medium-swell							
1C0	2,5 to 15	±20 [1]	—	—	50	—	+10 to +60
1C1	15,1 to 35	±20	—	—	50	—	+10 to +60
1C2	35,1 to 65	±20	—	—	50	—	+10 to +60
1C3	65,1 to 95	±20	—	—	50	—	+10 to +60
1C4	95,1 to 125	±20	—	—	50	—	+10 to +60
1C5	125,1 to 200	±20	—	—	50	—	+10 to +60
1C6	200,1 to 300	±20	—	—	50	—	+10 to +60
Class D, high-temperature-resistant							
1D0	2,5 to 15	—	±10	5	—	50	—
1D1	15,1 to 35	—	±10	5	—	30	—
1D2	35,1 to 65	—	±10	5	—	30	—
1D3	65,1 to 95	—	±10	5	—	30	—
1D4	95,1 to 125	—	±10	5	—	30	—
1D5	125,1 to 200	—	±10	5	—	30	—

1) If, after ageing, this grade still falls within the compression-deflection requirement of 2,5 kPa to 15 kPa, it shall be considered acceptable even though the change from the original value is greater that ±20 %.

Table 2 — Physical requirements for cellular rubbers, type 2, closed-cell (expanded) rubber

Basic requirements								
Grade No.	Compression deflection at 25 % Deflection at 23 °C ± 2 °C	Compression deflection after conditioning — Change from original value			Compression set under constant deflection of 50 %		Water absorption 3 min at 23 °C ± 2 °C	Fluid resistance 168 h at 23 °C ± 2 °C Change in mass in ISO 1817 liquid B
		22 h at 70 °C ± 1 °C	22 h at 150 °C ± 2 °C	5 h at −55 °C ± 2 °C	22 h at 23 °C ± 2 °C	22 h at 100 °C ± 1 °C	Mass of water uptake	
	kPa (Limits)	% (Limits)	% (Limits)	% (Max.)	% (Max.)	% (Max.)	% (Max.)[1]	% (Max.)[2]
Class A, non-oil-resistant								
2A1	15,1 to 35	±30	—	—	25	—	5 or 10	—
2A2	35,1 to 65	±30	—	—	25	—	5 or 10	—
2A3	65,1 to 95	±30	—	—	25	—	5 or 10	—
2A4	95,1 to 125	±30	—	—	25	—	5 or 10	—
2A5	125,1 to 200	±30	—	—	25	—	5 or 10	—
2A6	200,1 to 300	±30	—	—	25	—	5 or 10	—
Class B, oil-resistant, low-swell								
2B1	15,1 to 35	±30	—	—	25	—	5 or 10	50
2B2	35,1 to 65	±30	—	—	25	—	5 or 10	50
2B3	65,1 to 95	±30	—	—	25	—	5 or 10	50
2B4	95,1 to 125	±30	—	—	25	—	5 or 10	50
2B5	125,1 to 200	±30	—	—	25	—	5 or 10	50
2B6	200,1 to 300	±30	—	—	25	—	5 or 10	50
Class C, oil-resistant, medium-swell								
2C1	15,1 to 35	±30	—	—	25	—	5 or 10	150
2C2	35,1 to 65	±30	—	—	25	—	5 or 10	150
2C3	65,1 to 95	±30	—	—	25	—	5 or 10	150
2C4	95,1 to 125	±30	—	—	25	—	5 or 10	150
2C5	125,1 to 200	±30	—	—	25	—	5 or 10	150
2C6	200,1 to 300	±30	—	—	25	—	5 or 10	150
Class D, high-temperature-resistant								
2D1	15,1 to 35	—	±5	5	—	80	5 or 10	—
2D2	35,1 to 65	—	±5	5	—	60	5 or 10	—
2D3	65,1 to 95	—	±5	5	—	60	5 or 10	—
2D4	95,1 to 125	—	±5	5	—	60	5 or 10	—
2D5	125,1 to 200	—	±5	5	—	60	5 or 10	—

1) For cellular materials with densities not exceeding 160 kg/m^3, the value of water absorption allowed is 10 % max. by mass. For densities greater than 160 kg/m^3, the maximum permitted value of water absorption is 5 % by mass.

2) This test (annex F) of mass change in liquid B is used in place of the usual oil resistance test of volume change in No. 3 oil for the following reason. Oil or solvent immersion of flexible closed-cell materials usually causes loss of gas, by diffusion through the softened cell walls, which results in some shrinkage of the test piece. This shrinkage counteracts the swell which would normally occur, thus invalidating test data based on volume change. Liquid B is used because it produces a wider and more consistent differentiation between classes A, B and C than does the No. 3 oil.

Standard oil resistance test methods give inconsistent results on closed-cell materials. This test gives a general indication of oil resistance, but more reliable information should be obtained by testing in actual or simulated service conditions.

The figures of 150 % max. for class C and 50 % max. for class B apply to cellular materials having densities greater than 160 kg/m^3. For cellular materials with densities not exceeding 160 kg/m^3, the maximum permitted values of mass change are 250 % for class C and 100 % for class B.

Table 3 — Physical requirements for cellular rubbers with added suffix letter

Grade No.	Requirements added by suffix letter								
	Suffix								
	A1	B1	C1	C2	C3	C4	F1	F2	F3
	Compression deflection after conditioning for 22 h at 175 °C ± 2 °C Change from original compression deflection % (Limits)	Compression set under constant deflection of 50 % 22 h at 70 °C ± 1 °C % (Max.)	Ozone test at 25 pphm Visual examination	Ozone test at 50 pphm Visual examination	Ozone test at 100 pphm Visual examination	Ozone test at 200 pphm Visual examination	Low-temperature test at −40 °C ± 2 °C Change from original compression deflection % (Max.)	Low-temperature test at −55 °C ± 2 °C Change from original compression deflection % (Max.)	Low-temperature test at −75 °C ± 2 °C Change from original compression deflection % (Max.)
Class A, non-oil-resistant									
1A0	—	15	Crack-free	Crack-free	Crack-free	Crack-free	25	25	—
1A1	—	15	Crack-free	Crack-free	Crack-free	Crack-free	25	25	—
1A2	—	15	Crack-free	Crack-free	Crack-free	Crack-free	25	25	—
1A3	—	15	Crack-free	Crack-free	Crack-free	Crack-free	25	25	—
1A4	—	15	Crack-free	Crack-free	Crack-free	Crack-free	25	25	—
1A5	—	15	Crack-free	Crack-free	Crack-free	Crack-free	25	25	—
1A6	—	15	Crack-free	Crack-free	Crack-free	Crack-free	25	25	—
Class B, oil-resistant, low-swell									
1B0	—	—	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1B1	—	—	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1B2	—	—	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1B3	—	—	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1B4	—	—	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1B5	—	—	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1B6	—	—	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
Class C, oil-resistant, medium-swell									
1C0	—	25	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1C1	—	25	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1C2	—	25	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1C3	—	25	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1C4	—	25	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1C5	—	25	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
1C6	—	25	Crack-free	Crack-free	Crack-free	Crack-free	50	—	—
Class D, high-temperature-resistant									
1D0	±25	—	Crack-free	Crack-free	Crack-free	Crack-free	—	—	25
1D1	±25	—	Crack-free	Crack-free	Crack-free	Crack-free	—	—	25
1D2	±25	—	Crack-free	Crack-free	Crack-free	Crack-free	—	—	25
1D3	±25	—	Crack-free	Crack-free	Crack-free	Crack-free	—	—	25
1D4	±25	—	Crack-free	Crack-free	Crack-free	Crack-free	—	—	25
1D5	±25	—	Crack-free	Crack-free	Crack-free	Crack-free	—	—	25

Table 4 — Test methods

Requirement or suffix letter	Basic requirements	Suffix numbers			
		1	2	3	4
Compression deflection	Annex A				
Suffix A, heat resistance	Annex B Change in deflection a) Type 1, classes A, B, C 168 h at 70 °C ± 1 °C b) Type 2, classes A, B, C 22 h at 70 °C ± 1 °C c) Class D 22 h at 150 °C ± 2 °C	Annex B 22 h at 175 °C ± 2 °C			
Suffix B, compression set	Annex D a) Type 1, classes A, B, C 22 h at 70 °C ± 1 °C b) Type 2, classes A, B, C 22 h at 23 °C ± 2 °C c) Class D 22 h at 100 °C ± 1 °C	Annex D 22 h at 70 °C ± 1 °C			
Suffix C, ozone resistance		ISO 1431-1 20 % strain 40 °C 25 pphm	ISO 1431-1 20 % strain 40 °C 50 pphm	ISO 1431-1 20 % strain 40 °C 100 pphm	ISO 1431-1 20 % strain 40 °C 200 pphm
Suffix E, fluid resistance	Annex C a) Type 1 22 h at 70 °C ± 1 °C Oil No. 3 Annex F b) Type 2 168 h at 23 °C ± 2 °C Liquid B				
Suffix F, low-temperature resistance	Annex G Change in compression deflection after 5 h at −55 °C ± 2 °C	Annex G −40 °C ± 2 °C	Annex G −55 °C ± 2 °C	Annex G −75 °C ± 2 °C	
Suffix L, water absorption (type 2 only)	Annex E 3 min at 23 °C ± 2 °C				
Suffix M, flammability resistance	Customer agreement				
Suffix P, staining resistance, xenon arc	Reference 3 fading to contrast grade 4	ISO 3865:1983, method A2 No contact stain	ISO 3865:1983, methods A2 and B No contact stain No leaching		

5 Physical properties

The various types, classes and grades of cellular rubber shall conform to the physical property requirements given in tables 1 and 2, together with any additional requirements indicated by any suffix letter as described in table 3 and any number given in the designation as described in clause 3.

6 Methods of test

6.1 Unless specifically stated otherwise, all tests shall be carried out in accordance with the methods specified in the annexes to this part of ISO 6916.

6.2 Test pieces shall not be tested for at least 72 h after manufacture. Prior to test, the test pieces shall be stored for at least 16 h at either 23 °C ± 2 °C and (50 ± 5) % relative humidity or 27 °C ± 2 °C and (65 ± 5) % relative humidity. This period may form the latter part of the time following manufacture.

6.3 When 23 °C ± 2 °C or the phrase "standard temperature" is stated in this document, it shall be taken to mean that the standard temperatures of 23 °C ± 2 °C or 27 °C ± 2 °C may be used when appropriate (see ISO 471).

7 Dimensional tolerances

The tolerances allowable on the dimensions of cellular rubber sheet shall be as specified in table 5.

8 Inspection and rejection

8.1 All tests and inspections shall be carried out at the place of manufacture prior to shipment, unless otherwise specified. The manufacturer shall afford the inspector all reasonable facilities for tests and inspection.

8.2 The purchaser may carry out the tests and inspections to govern acceptance or rejection of the material at his own laboratory or elsewhere. Such tests and inspections shall be made not later than 15 days after receipt of the material.

8.3 All samples for testing, provided as specified in clause 11, shall be visually inspected to determine compliance with the material, workmanship and colour requirements.

8.4 Any material that fails in one or more of the test requirements may be retested. For this purpose, two additional tests shall be made for the requirement in which failure occurred. Failure of either of the retests shall be cause for final rejection.

8.5 Rejected material shall be disposed of as directed by the manufacturer.

9 Packaging and marking

The material shall be properly and adequately packaged. Each package or container shall be legibly marked with the name of the material, the name or trademark of the manufacturer, and any required purchaser's designations.

Table 5 — Tolerances on dimensions of cellular-rubber sheet for general applications

Form	Thickness		Length and width	
	Dimension (mm)	**Tolerance, plus or minus** (mm)	**Dimension** (mm)	**Tolerance, plus or minus** (mm)
Sponge rubbers				
Sheet	⩽ 3,2 3,3 to 15 15,1 to 30 30,1 to 50 > 50	0,4 0,8 1,5 2,0 2,5	⩽ 152 > 152 but ⩽ 457 > 457	1,6 3,2 0,5 %
Expanded rubbers				
Sheet	⩽ 3,2 3,3 to 15 15,1 to 30 30,1 to 50 > 50	0,4 0,8 1,5 2,0 2,5	⩽ 152 > 152 but ⩽ 305 > 305	6,4 9,6 3 %

10 Sampling

10.1 When possible, the finished manufactured product shall be used for the tests specified.

10.2 When it is necessary or advisable to obtain test pieces from the article, as in those cases where the entire sample is not required or adaptable for testing, the method of cutting and the exact position from which test pieces are to be taken shall be specified. The apparent density and the state of cure may vary in different parts of the finished product. Also, the apparent density is affected by the number of cut surfaces as opposed to the number of skin-covered surfaces on the test pieces.

11 Test pieces and sheets

11.1 Test pieces

Standard test pieces intended for the compression deflection test shall be discs cut by a die either $(30^{+0,04}_{0})$ mm or $(19^{+0,04}_{0})$ mm in diameter. The test pieces may be cut with a revolving die using a soap solution as lubricant. If a lubricant is used, the test pieces shall be thoroughly dried before proceeding with the testing. In some cases, it may be necessary to freeze the cellular rubber to obtain a good cylinder. When cut from standard test slabs, test pieces shall be cut from the centre area as shown in figure 1. The thickness shall be measured as described in clause 12. As stated in the test methods, the minimum thickness of test pieces is 6,0 mm. Plied-up samples may be used as indicated in the test methods for compression set and compression deflection.

NOTE 3 When the available material widths are too small to allow standard test pieces to be cut, then smaller diameter discs may be used. Test results obtained on smaller discs may not be the same as on standard test pieces.

11.2 Test sheets

11.2.1 Standard test sheets of all types of cellular rubber shall be pieces 150 mm ± 5 mm square and 12,5 mm ± 5 mm in thickness, made from the same compound and having the same apparent density and state of cure as the product they represent. In all cases, the surface skin shall be left intact on both top and bottom faces of the test sheet. Standard test sheets shall be prepared either by cutting them from flat sheets of the specified thickness or as described in 11.2.2 or 11.2.3.

Dimensions in millimetres

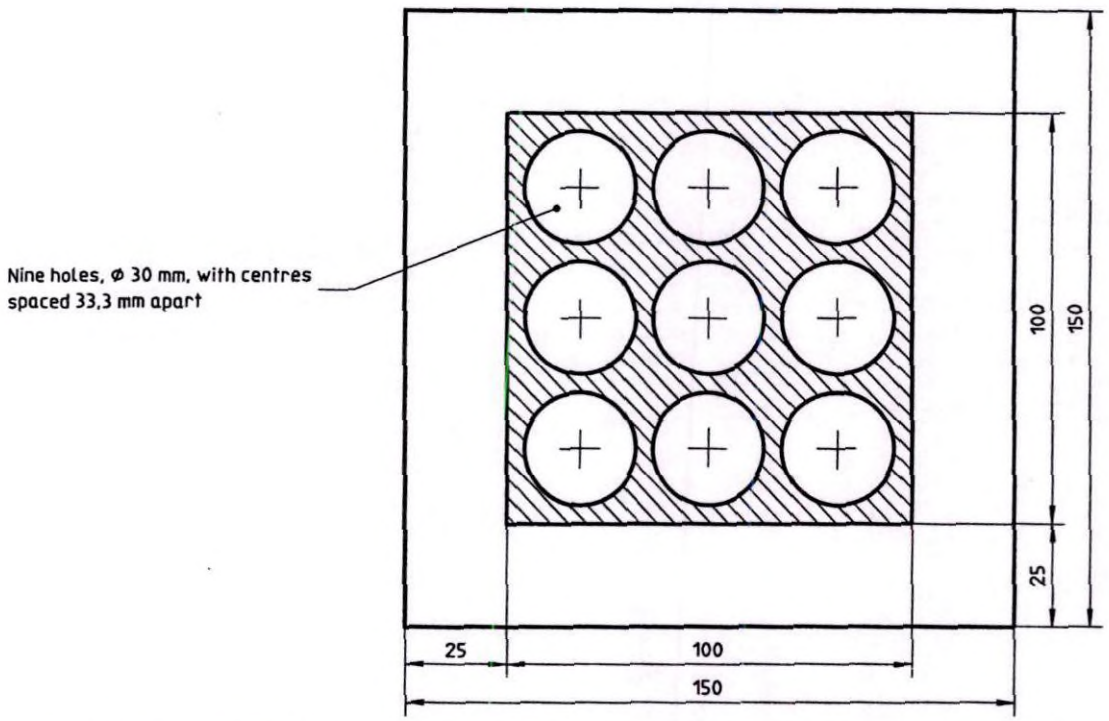

Figure 1 — Locations from which standard test pieces are to be cut when testing standard test slabs or commercial flat sheets

11.2.2 When specially prepared standard test sheets of sponge rubber are required, they shall be made using the frame shown in figure 2 together with top and bottom plates each approximately 12,5 mm in thickness. The frame and plates shall be made of aluminium or steel. The compound shall be cut into squares slightly smaller than the frame cavities. The thickness shall be such as to give the required apparent density when the material is blown during cure to fill the moulding cavities. The squares of stock shall be dusted with talc and the excess brushed off to avoid pitting. They shall then be placed in the frame, and fabric sheeting shall be applied on the top and bottom between the frame and the plates to allow venting of gases produced during the cure. This fabric shall be commercial sheeting with a mass per unit area of approximately 135 g/m^2, having approximately 2,75 ends/mm and 2,36 picks/mm. For materials with suitable flow characteristics the use of grooved plates may be an alternative method to fabric sheeting. The test pieces shall be vulcanized in a platen press under conditions of time and temperature chosen to produce a state of cure of the standard sheets approximately the same as in the finished products which they represent.

11.2.3 When specially prepared standard test sheets of expanded rubber are required, the final stage of cure shall be done using the frame described in 11.2.2 and using the same process that was used for the product to be represented by the test sheet. The test pieces shall be prepared to have approximately the same density and shall be vulcanized under conditions of time and temperature chosen to produce a state of cure in the standard sheets approximately the same as in the finished products which they represent.

12 Measurement of test-piece dimensions

The dimensions of test pieces shall be measured in accordance with ISO 1923.

Dimensions in millimetres

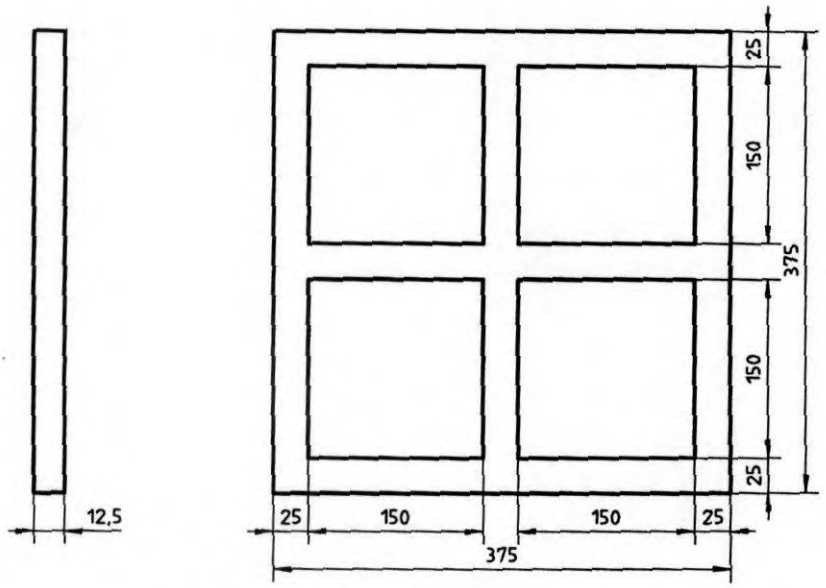

Figure 2 — Four-cavity frame for standard test slabs of cellular rubbers

Annex A
(normative)

Compression deflection tests

A.1 Apparatus

Any compression machine that meets the following requirements will be satisfactory. The machine shall be capable of compressing the test piece at a rate of 0,20 mm/s to 0,85 mm/s gently without impact. The machine may be motor- or hand-driven. It shall be equipped with a gauge to measure the deflection caused by the increase in load. The rate of compression of the test piece is specified rather than the rate of movement of the compression platform of the machine. This is an important consideration when scales are used, since sponges of various compression deflection characteristics will require different times to compress 25 % due to the travel of the scale platform under varying loads. The accuracy of the test machine shall conform to grade A of ISO 5893:1993.

The deflection shall be read on a dial gauge graduated in units of 0,02 mm. No gauge is necessary if the machine automatically compresses the test piece 25 %.

The top and bottom plates of the test machine shall be at least 38 mm in diameter.

A.2 Test pieces

Standard test pieces as defined in 11.1 shall be used for this test. They shall be cut so that opposite edges are parallel, either from the standard test slabs of flat sheets as shown in figure 1, or from the finished product in a manner agreed upon by the parties concerned.

The thickness of each standard test piece shall be $(6{,}0^{+0{,}5}_{0})$ mm. Alternatively, no more than three thin samples may be plied up to obtain the minimum possible excess over this thickness without cutting.

NOTE 4 In sponge rubbers, using the same compound, thin sections under 6 mm do not blow in the same manner as those over 6 mm. The thinner sections are usually higher in compression deflection and density. However, in closed-cell (expanded) rubbers where thin sheets are split from thicker sheets, there is usually very little difference between the thin sheet and the thicker sheets.

A.3 Procedure

Measure the test-piece diameter and thickness in accordance with clause 12 and record the values. Compress the standard test piece between the parallel metal plates of the test machine until the thickness has been reduced by 25 %, and take the reading of the load immediately.

A.4 Expression of results

Calculate the compression stress B, in kilopascals, at 25 % compression from the equation

$$B = \frac{4F \times 10^6}{\pi d^2}$$

where

F is the compression force, in kilonewtons, at 25 % compression;

d is the diameter, in millimetres, of the test piece.

A.5 Test report

Report the compression stress, in kilopascals, at 25 % compression as the result of the compression deflection test, together with the thickness of the test piece.

Annex B
(normative)

Heat resistance test

B.1 Test pieces

The test pieces used in any of the ageing tests shall be those required by the cellular-rubber methods for the particular determination to be employed for measuring the effects of ageing exposure.

B.2 Procedure

The air-oven ageing test as described in ISO 188 shall be used for cellular rubbers, except that the test-piece size shall be appropriate for compression deflection testing. Deterioration shall be expressed as the percentage change in compression deflection values. The compression deflection test shall be based on the original (before ageing) test-piece thickness. No relation between accelerated ageing tests and natural ageing is given or implied.

Annex C
(normative)

Oil resistance test

C.1 Test pieces

Standard test pieces approximately 12,5 mm in thickness shall be used for this test. The diameter and thickness shall be measured in accordance with clause 12 before and after immersion in the specified petroleum-based oil (see ISO 1817) for 22 h at 70 °C and the percentage change in volume calculated.

Three test pieces shall be used in each test and the median of the three values reported.

C.2 Procedure

Follow the procedure of ISO 1817 using petroleum-based oil No. 3.

Annex D
(normative)

Compression set under constant deflection

D.1 Test pieces

Standard test pieces shall be used for this test. They shall be cut so that opposite edges are parallel, either from the finished product in a manner agreed upon by the parties concerned, or from standard test slabs or from commercial flat sheets. The thickness of the test pieces may vary. The minimum thickness for open-cell (sponge) rubber shall be 6 mm. Thin samples of open-cell rubber may be plied up to obtain this thickness. The minimum thickness for closed-cell (expanded) rubber shall be 12,5 mm. Thin samples of closed-cell rubber shall be plied up to obtain this thickness.

D.2 Procedure

The apparatus and procedure shall basically be the same as that described in ISO 815. Measure the test-piece thickness.

For open-cell (sponge) rubbers, compress test pieces to 50 % of their original thickness. Release the load at the end of the test period and measure the thickness after 30 min rest at room temperature. The temperature of the test for open-cell rubber shall be 70 °C ± 1 °C.

For closed-cell (expanded) rubbers, compress test pieces to 50 % of their original thickness. Release the load at the end of the test period and measure the thickness after 24 h at room temperature. The temperature of the test for closed-cell rubbers shall be 23 °C ± 2 °C.

In both cases (open-cell and closed-cell rubbers), measure the thickness as described in clause 12. The time of the test shall be as specified. Chromium-plated metal plates are not required. Aluminium plates, or any stiff plates that are clean and smooth and will not deflect measurably under the load necessary for deflection of the test piece, may be used.

D.3 Expression of results

Calculate the percentage compression set from the formula

$$\frac{d_o - d_r}{d_o - d_s} \times 100$$

where

d_o is the original thickness, in millimetres, of the test piece;

d_r is the thickness, in millimetres, of the test piece after the specified recovery period;

d_s is the thickness, in millimetres, of the spacer bar used.

Annex E
(normative)

Water absorption test

NOTE 5 The water absorption test is applicable to *expanded rubbers (closed-cell type). It is unsuitable for use* on sponge rubbers (open-cell type) unless they are completely encased in an added skin.

E.1 Test pieces

Test pieces approximately 12,5 mm in thickness and 2 500 mm^2 in area shall be used for this test. Disc test pieces are preferable.

E.2 Procedure

Weigh the test pieces to the nearest 0,01 g. Submerge them in distilled water at room temperature (23 °C ± 2 °C) 50 mm below the surface of the water, and reduce the pressure above the water to 17 kPa for 3 min. Release the vacuum, and allow the test pieces to remain submerged for 3 min at atmospheric pressure. Remove the test pieces, blot them dry, reweigh, and calculate the percentage change in mass.

Annex F
(normative)

Fluid resistance test

F.1 Apparatus

The equipment required is an analytical balance, tared weighing bottles, screens, ISO reference liquid B (see ISO 1817), filter paper and 250 cm^3 containers with lids.

F.2 Test pieces

Test pieces shall be (25 ± 0,5) mm × (50 ± 0,5) mm × (6 ± 0,5) mm. It is preferable that the test pieces be cut with clean, square edges.

F.3 Procedure

Weigh the test pieces to the nearest 0,01 g. Place a non-corrosive screen having 2-mm openings on the bottom of the container. Place a maximum of three test pieces of a single material alternating with the same number of screens into each container. Fill the containers with ISO reference liquid B (see ISO 1817) and seal with their lids. Store the containers for 7 days at a temperature of 23 °C ± 2 °C. Remove one test piece at a time from the test fluid. Without squeezing the test piece, place it on top of one sheet of filter paper and immediately place a second sheet of filter paper on top of it. Blot lightly without squeezing, then remove the top filter paper and slide the test piece from the bottom filter paper into a tared weighing bottle. Determine the mass of the test piece to the nearest 0,01 g.

F.4 Expression of results

Calculate the percent change in mass of each test piece and report the median value.

Annex G
(normative)

Low-temperature resistance test

G.1 Apparatus

The apparatus shall consist of two parallel plates at least 38 mm in diameter, one of which is movable and the other one stationary, a means of applying a load, and a means of accurately measuring the distance between the parallel plates.

G.2 Test pieces

Standard test pieces shall be used for this test. The thickness shall be measured and stated in the test report. The minimum thickness shall be 6,0 mm. Plied-up test pieces are not satisfactory. The test pieces shall be dried in a desiccator for 16 h before testing.

G.3 Procedure

Measure the compression deflection of each test piece first at standard temperature (see ISO 471) and record the stress, in kilopascals, necessary to obtain a 25 % deflection. Place the test piece in a cold box for 5 h at the specified temperature, at the end of which time apply the previously determined load as rapidly as possible while the test pieces are still in the cold box, and record the deflection within 30 s.

G.4 Expression of results

Calculate the percentage change in deflection C from the equation

$$C = \frac{D - E}{D} \times 100$$

where

D is the deflection at the standard temperature;

E is the deflection at the temperature of the test.